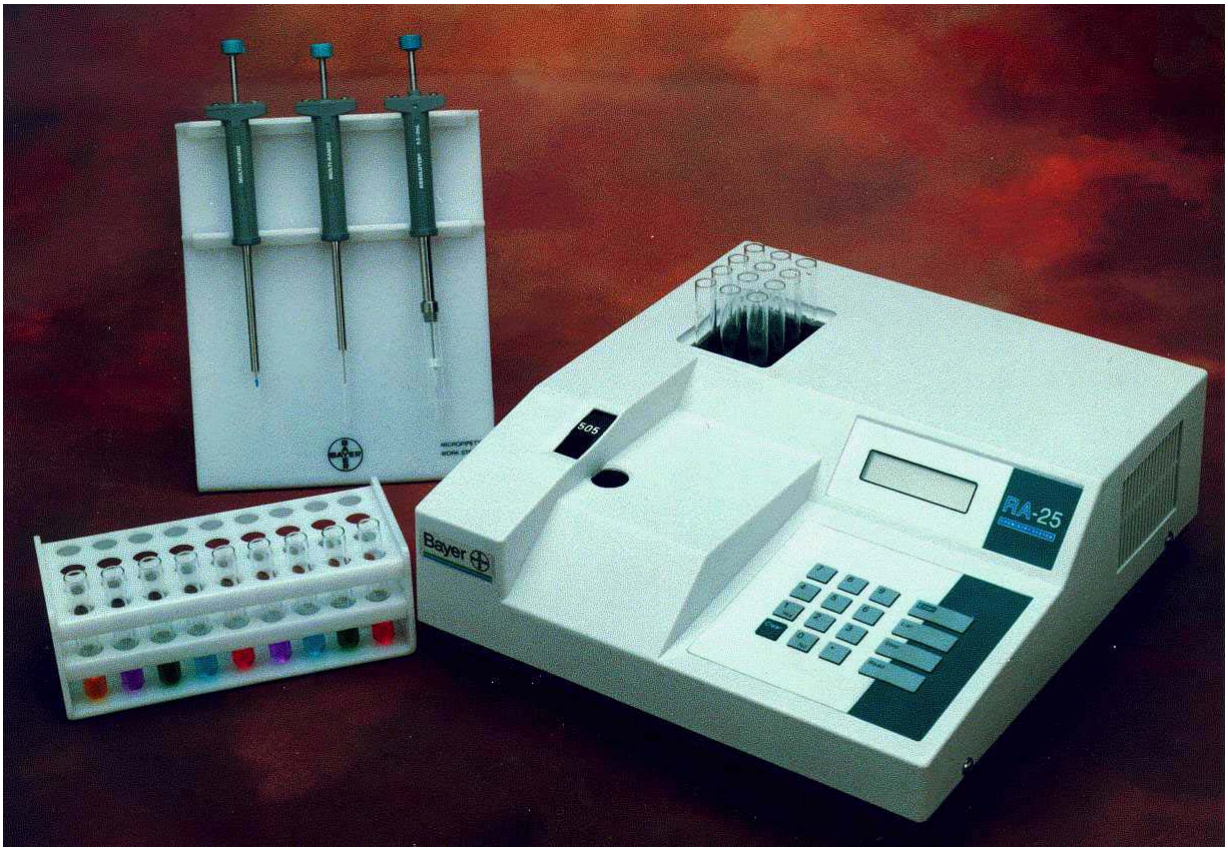
RA-25 Service Manual



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1.0 TECHNICAL SPECIFICATIONS

1.	Photometric Accuracy		:	± 3%
2.	Light Source		:	3.7 Volt / 1 W, Lens End Incandescent Lamp.
3.	Spectral Range		:	320 to 700 nm
4.	Wave Length Range		:	340,405,505,546 and 630 nm.
5.	Band Pass		:	±10 nm
6.	Photometric Range		:	-2.500 A to +2.500 A
7.	Power Supply		:	220V A.C, 50 Hz 110V A.C, 60 Hz
8.	Power Consumption		:	Max. 50 Watts
9.	Fuse Requirement		:	220V A.C. 1 Amp, Fast Acting
10.	Operating Temperature		:	18°C to 32°C
11.	Relative Humidity		:	85% at 30°C non-condensing.
12.	Incubator Temperature		:	37.5°C ± 0.2 °C
13.	Display		:	16 x 2 Characters, Alpha Numeric LCD.
14.	Microprocessor		:	8 bit
15.	Memory		:	32 KB EPROM, 384 KB E^2PROM , 128 Byte RAM
16.	Interface		:	RS232 C
17.	Dimensions	Height	:	115 mm
		Width	:	300 mm
		Depth	:	321 mm
		Weight	:	5.4 Kg

2.0 BLOCK DIAGRAM

The Block Diagram of RA-25 is shown in Diagram No.64050009. All the Block Diagram Circuits are mounted on the following Printed Circuit Boards.

- CPU PC Board
- Inter-Connecting PC Board
- Heater Circuit PC Board
- Photodiode PC Board
- PTC PC Board

CPU PC Board:

This Board comprises of the following Circuits:

- Main Power Supply
- Crystal Clock
- Photometeric I/V Converter and Logarithmic Converter
- Key Board/Display Control
- Power ON reset
- Main Program Storage
- Parameters Data Storage
- Heater Circuit Control
- Temperature Sensor
- Battery supply and charger circuit
- RS232 C Interface for Printer
- Photo detector

INTER-CONNECTING PC BOARD:

This Board comprises the following circuits:

- ☺ Display Control
- ☺ Buzzer Interface

HEATER CIRCUIT PC BOARD:

This comprises of Transistors TIP-127. These Transistors gets control signal and DC supply from CPU Board. This is used to heat the Incubator Block to 37.5 °C ± 0.2 °C.

PHOTODIODE PC BOARD:

This comprises of Photodiode G1126-2. This is used to sense photometrically the selected light beam which crosses the Test-well and Interferrential Filters.

PTC PC BOARD:

This comprises of PTC of 1K Ohm. This is used to regulate the set value of Temperature of Incubator-block.

3.0 MAIN POWER SUPPLY CIRCUIT:

The following Power supply Circuits are mounted on the CPU Board.

- ☺ +5V Supply
- ☺ +12V Supply
- ☺ Ni-Cd Battery Supply

+5V Supply:

This is the DC regulated supply comprises of Bridge Rectifier BR1, Diode D8, IC U14 and Capacitors C18, C16, C19 and C31. R53 Resistor is used to discharge the Capacitor C16 whenever Instrument is turned OFF. The supply drives all the Digital circuits and the Displays.

+12V Supply:

This is the un-regulated supply used to drive the following circuits:

- ✡ Heater Circuit
- ✡ Analogue Circuit
- ✡ Battery Charging Circuit

Ni-Cd BATTERY SUPPLY

This is the back-up supply to RA 25 to carry-out End-Point Chemistries. RA 25 will switch to this mode when AC supply goes OFF. During the AC mode Operation, Battery gets charged through Resistor R53 by a Trickle current.

4.0 INTER-CONNECTING PC BOARD:

This comprises of LCD Module and Buzzer Circuit. Keyboard is interfaced with this PC Board through connectors J1 & J2 and 8-wire flexible cables. CPU Board is interfaced with this PC Board through 26-wire flat cable. Buzzer Circuit is used to give a beep sound whenever any key of the keyboard is pressed. Whenever Keyswitch is pressed, signal is generated which is Inverted by U1 and is used to trigger the Monostable U2 for short duration. This output signal drives the Buzzer through the Transistor T1 to generate beep sound.

5.0 OPTICAL UNIT:

The main parts comprising of this unit are shown in Drawing No.64050008. The Incandescent Lamp of 3.7 Volt, 300mA is powered by voltage Regulator U12. Light from the lamp passes through Test-well, Interferrential filters and then to Photodiode. Incubator block has a Test-well in which Test cuvette is inserted. Interferrential Filters 340 nm, 405 nm, 505 nm, 546 nm and 630 nm filters are mounted on a Filter Wheel. Light beam which passes through the Test-well is selected by an Interferrential filter by moving Filter Wheel. Selected spectral beam falls on Photodiode, which then converts photometeric signal into corresponding current signal.

6.0 CPU PC BOARD:

Main functions of the PC Board :

- ☺ Logarithmic Conversion Section
- ☺ Temperature Control Section
- ☺ Power Supply Section
- ☺ Microprocessor Section
- ☺ Power ON Reset Circuit
- ☺ Clock Circuit
- ☺ Memory Section
- ☺ Peripheral ICs
- ☺ Printer Interface
- ☺ Lamp Circuit

LOGARITHMIC CONVERSION SECTION:

The output signal from the Photodiode goes through pins 4 and 5 of J2 to the current to voltage Converter OP AMP U4. Gain of the OP AMP U4 is adjusted with the help of Trimpot P1 and OFFSET of U4 Pin 3 is set by Trimpot R2. This signal is then converted logarithmically by the circuit comprising of two comparators U10 and two Transistors Q1 and Q2 The CPU 6303RP delivers the MEASURE (READ START) signal to the Comparators.

According to the amplitude of the Photometric signal, the two comparators toggles and changes their output states. One Comparator generates START signal by which lamp gets the supply for 2 SEC. Second Comparator generates the STOP signal which stops the conversion cycle. Within 2 SEC time period conversion process gets completed. OFFSET of OP AMP U10 pin 6 is set by Trimpot P2 and Gain of OP AMP U10 is set by Trimpot P3.

TEMPERATURE CONTROL SECTION:

Temperature Circuit consists of Heater Circuit PC Board with two Transistors TIP-127 mounted on Incubator Block. Heater Circuit gets +12V un-regulated supply through Transistor Q7 and is controlled by collector of Transistor Q6. A Temperature sensing PTC device is connected to pin 1 and 6 of J2 and drives the Temperature control circuit comprises of OPAMP U10, Transistor Q6 and Q5. Temperature of Incubator is set by Trimpot P4. When the Incubator Temperature is reached to the set value 37.5°C ±0.2°C, then Transistor Q6 goes OFF. Collector of Transistor Q5 goes to +5V which sets Pin 6 of U7 to Logic ?? This sends signals to 6303RP that correct Temperature has been reached. TEMP OK message is displayed on LCD.

POWER SUPPLY SECTION:

Power for the Heater Circuit PC Board is obtained through Pins 3 & 4 of J4 and Bridge Rectifier BR1. The required Voltage to Transistors TIP-127 on the Heater Circuit PC Board is delivered through connector J3.

In the event of AC supply being disconnected, the Ni-Cd Battery will power all photometric circuits except Heater Circuit through Pins 3 & 4 of J4 connector. Blinking 揣?message is displayed on LCD.

When Battery supply becomes insufficient (less than 8.5 Volts) then Comparator U10 will toggle and send the Low Battery Signal to Microprocessor 6303RP through pin 4 of U7.LOW BAT message is displayed on LCD.

+5V DC regulated is generated by voltage Regulator U14.

MICROPROCESSOR SECTION:

It comprises of CPU 6303RP and several Peripheral Interface IC担 that control all the external devices.

POWER ON RESET CIRCUIT:

This comprises of IC U8, Diode D1, Capacitor C12 and Resistors R8 and R21. This gives high pulse of 20 msec. to pin 6 of 6303RP to reset all the flip-flops and Registors of 6303RP and to synchronies the functions with the clock.

CLOCK CIRCUIT:

This comprises Crystal Y1 2.4576 MHz, parallel Capacitors C1 and C2 and high Resistance R6. This generates the Clock input frequency of 2.4576 MHz for 6303RP.

MEMORY SECTION:

- Main Program Storage - IC 27C256 - U5
- Parameter Data Storage - IC 93C46 - U9, U16, U17.
- 128 Byte RAM

MAIN PROGRAM STORAGE - IC 27C256- U5:

This EPROM is used to STORE the main Program of the Instrument. This program checks the logic circuits and controls the over all functions of the Instrument.

PARAMETER DATA STORAGE - IC 93C46 - U9, U16 and U17:

These ICs are used to store the Parameters. 25 chemistries Data担 are programmed in these Memories.

128 BYTE RAM:

This RAM is built in 6303RP. It is used on temporary storage of Data

PERIPHERAL IC担 :

- U2-74HC374
- U3-74HC374
- U6-74HC373
- U7-74HC244
- U11-74HC138

U2-74HC374 IC:

Receives Data from CPU and sends to LCD Display for displaying messages. This sends Address as well as Control and Data signals to Interconnecting PC Board.

U3-74HC374 IC :

6303 RP CPU sends scan code continuously to Keyboard through this IC. CPU sends Data of Parameters to store in E^2PROM U9, U16 and U17. CPU retrieves Data from these E^2PROM while working on Test Samples.

U6-74HC373 IC:

CPU 6303RP is working in Multiplexed mode. During first cycle after power is switched 慜N? it sends Low Byte Address bits on Data Lines. These Datas are latched in U6. During second cycle, CPU sends Higher bits of address on Address lines. Latched low Byte address in U6 and higher Byte address bits on address lines of CPU addresses U5-EPROM 27C256. U5 gets full Address to output Data on Data lines. U6 is used for Bi-directional Data transfer on Data Bus.

U7-74HC244 IC :

CPU 6303 RP receives 慜OW BAT?扷MP OK?and 慅C 慸ignals through this IC and sends messages on LCD Display for operators actions. Getting information on each Key of Keyboard being pressed for execution purpose.

U11-74HC138 IC :

This is a 3 to 8 line Decoder. It is used to select ICs U2, U7 and U3. Input to this ICs are Address Lines A12, A13, A14 and A15. These Address Lines are Decoded by U6 to select U2, U7 and U3.

- **Addresses:**

U2 - 74HC373 - Address 3000 HEX - LCD interface.
U3 - 74HC374 - Address 2000 HEX - Keyboard and E^2PROM, U9, U16 and U17.
U7 - 74HC244 - Address 4000 HEX - Keyboard ,慜OW BAT? Temp OK and AC signals Interface

PRINTER INTERFACE:

U15 RS232 C IC is used to interface the printer with following specifications.

- 8 bit data
- Serial communication
- One STOP bit
- One START bit
- 4800 baud rate

As there is no hand shaking hardware facility available, 6303RP transmits the data serially without any interruption to Printer unit through J11 connector.

LAMP CIRCUIT:

6303RP sends the lamp ON signal through Pin 13 of U1 to Transistor Q4, Q3 to switch ON the voltage Regulator U12 to supply the regulated power to Lamp. Intensity of the Lamp is controlled by Trimpot P5. Lamp gets supply through connector J2-pins 2 and 3.

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1.0 FOREWORD :

The purpose of this section is to guide the service technician to repair the Instrument by deleting eventual faulty blocks. The block, as a whole, should be considered as being a replacement part to be repaired at Bayer Diagnostics India担 facility.

2.0 REQUIRED TEST EQUIPMENTS AND TOOLS:

Any type of servicing, be it trouble shooting or just verifying Instrument operation, requires the following equipments:

- Servicing Tool Kit

3.0 REPLACEMENT SPARES:

Following Spares are required for RA-25

	SPARES	**PART NO**.
1.	CPU PC Board	BDIL 5280A
2.	Inter-Connecting PC Board	BDIL 5270A
3.	Heater Circuit PC Board	BDIL 5240A
4.	Photodiode PC Board	BDIL5230A
5.	PTC PC Board	BDIL 5220A
6.	Transformer	BDIL 1419
7.	AC Line Filter	BDIL 1414
8.	Fuse Holder	BDIL 1415
9.	Fast Blow Fuse, 1 Amp.	BDIL 1411
10.	Rocker Switch	BDIL 1416
11.	Auto Read Switch	BDIL 1308
12.	Lamp Assembly	BDIL 1091A
13.	9.6V Ni-Cd Rechargeable Battery Pack	BDIL 1071
14.	Membrane Key Board	BDIL 1301
15.	LCD Module	BDIL 1001
16.	110V/220V Selector Switch	BDIL 1417
17.	Filter Wheel with Interferrential Filters	BDIL 1452A

4.0 MAINTENANCE AND ADJUSTMENTS.

CPU PC BOARD ADJUSTMENTS:

The Trimpot P4, is used to adjust a Temperature of 37.0°C ± 0.2°C on the Incubator Block. Gain of the OPAMP U4 is adjusted with the help of Trimpot P1. OFFSET of U4 Pin 3 is set by Trimpot R2. All the other Trimpots are Factory set.

5.0 INDEX OF PICTORIALS

SR NOS.	DESCRIPTION	DRAWING NOS.
1	Block Diagram	64050009
2	CPU PC Board Circuit Diagram	640100
3	CPU PC Board Assembly Diagram	64030101
4	Inter-Connecting PC Board Circuit Diagram	640200
5	Inter-Connecting PC Board Assembly Diagram	64030201
6	Photo Diode PC Board Circuit Diagram	640400
7	Photo Diode PC Board Assembly Diagram	64030401
8	PTC PC Board Circuit Diagram	640500
9	PTC PC Board Assembly Diagram	64030402
10	Heater Circuit PC Board Circuit Diagram	640600
11	Heater Circuit PC Board Assembly Diagram	64030403
12	Optic Unit Assembly Diagram	64050008
13	Isometric View of RA-25	64030001
14	Wiring Diagram of RA-25 Bottom Chassis	64031101

6.0 TROUBLE SHOOTING:

This section contains the flow-charts relevant to trouble shooting.

FLOW CHARTS	DRAWING NOS
The Instrument does not turn 憸N?	64050006
Temperature not OK	64050005
Lamp is not 憸N	64050004
LCD Display Blank	64050003
Analytic results incorrect	64050007

7.0 REPLACEMENT OF FILTERS AND LAMPS:

A. Replacement of Filters:
Replacing any Filter of Filter wheel is very simple and Engineers does not require to memorize. He has to just follow the following chart.

Sr No	Filter Wheel position on Top Cover	Filter in the slot for replacement
1	340 nm	546 nm
2	405 nm	630 nm
3	505 nm	340 nm
4	546 nm	405 nm
5	630 nm	505 nm

Engineer has to replace the filter with the help of circlip plier. Remove the filter and ND filter from the filter wheel with the help of circlip plier. Assemble new filter and old ND filter in the filter wheel. Measure the filter voltage. Measure other filters voltages. Take the linearity with the help of liquid solutions or Glass filters. Linearity should be within the specifications. Instrument is now OK.

B. Replacement of Lamps:
Engineers will be provided Lamp with connector and cable (complete assembly). Remove defective Lamp from the Incubator Block. Assemble new Lamp assembly. Measure the Lamp on voltage. Set it if it is not as per specifications. Measure other filters voltages. Set them if they are not within specifications. Take linearity with the liquid solutions or Glass filters. Set them if they are not within the specifications. Instrument is now OK.

Recommended Tool Kit for Servicing RA-25

1. 4 1/2 Digit Digital Multimeter
2. Soldering Iron and Desoldering Pump
3. Glass Filters Set/Potesium dichromate solutions
4. Screw Driver Set
5. Circlip Plier
6. Plier
7. Filter Wheel Alignment Tool
8. 12/13 Ring Spanner
9. Cutter
10. Forceps
11. Magnifying Glass
12. Solder Wire
13. Nylon Brush
14. Isopropyl Alcohol Solution
15. Heat Sink Compound
16. Fevikwick
17. Fevibond
18. Knife Blade

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1.0 TECHNICAL SPECIFICATION

1.	Power Supply		:	10V A.C from RA-25
2.	Printing Method		:	Serial Impact Dot Matrix
3.	No. of Columns		:	24 Columns
4.	Microcontroller		:	8 Bit
5.	Memory		:	4 KB Flash Memory 128 Byte RAM
6.	Operating Temperature		:	18°C to 32°C
7.	Relative Humidity		:	85% at 30°C non-condensing
8.	Paper		:	Thermal
9.	Paper Width		:	58 mm ±0.5 mm
10.	Printing Speed		:	0.8 Lines/Sec
11.	Dimensions	Height	:	45 mm
		Width	:	132 mm
		Depth	:	151 mm
		Weight	:	0.4 Kg

2.0 BLOCK DIAGRAM

- J5 Connector
- Power Supply
- J1 ON/OFF Switch
- RS 232 C Serial I/P U4
- Micro Controller U3
- Data Storage Memory U6
- Data Buffer U7
- Mechanism Driving Circuit U8
- Printing Intensity Control Circuit U8
- Paper Feed Logic
- Paper Feed Switch J1
- Printer Mechanism J3
- Printer Mechanism J2

3.0 MAIN POWER SUPPLY

This is the D.C regulated supply comprises of Bridge Rectifier made up of Diode N1, N2, N3 and N4 and Capacitors C1 and C2 and Voltage regulator IC LM317U1. 10V A.C supply is received from RA 25 through Printer Interface cable connected to J5 connector. 10V A.C supply is rectified by Diodes N1, N2, N3 and N4 and regulated by Capacitors C1 and C2 and Voltage regulator IC LM317 U1. This +5V regulated supply drives all the Digital circuits and Printer mechanism.

4.0 THERMAL PRINTER PC BOARD

Printer Controller Card:

Printer unit is not a stand alone unit. It will work only with RA 25 Instrument through 9 pin Printer interface cable.

Main functional Blocks Drawing No:64050021 are as under:

RS 232 C-U4:

This is the Serial Input-Output port. This receives signal from RA 25 and prints on the Thermal printer. RS 232 port on Instrument side, receives +5V and Ground level Signals and converts into +12V and Ground level signals for transmitting through Printer Interface Cable to RS 232 port on Printer controller PC board. RS 232 port on Printer controller PC board converts +12V and Ground level signals to +5V and Ground level signals for processing. This is the Input-Output Interface port but used as only receiving port. It does not transmittes data to Instrument from Printer Controller PC Board. There is no handshaking facility.

89C51-U3 :

This is a 8 Bit Microcontroller IC. It has 4 KB of flash PEROM, 128 Byte of SRAM, 32 Programmable serial ports.

Port 0 (8 Bit):

Port 0 is used for low byte Address bus latch and Data transfer. Low byte address is latched in U5-74HC373 by high level of ALE-Address latch enable bit. This IC will be programmable by EPROM programmer externally.

Port 1 (8 Bit) :

This port is Bi-Directional Data transfer port. It transmits printing Data to Buffer IC U7-74HC240.

Port 2 (8 Bit) :

This port is used to send Higher Byte of Address on A8 to A15 address lines. This sends address to external Data Memory RAM U6-62C256 Memory IC.

Port 3 (8 Bit) :

This port is used to serve some special function as under:

Port Pin	Alternate Function
P3-0	RXD - Serial Input port - Receives data from RS 232 C IC
P3-1	TXD - Serial Output port - Transmitts data from MPU to RS232 C
P3-2	INT 0-External.Interrupt 0 - This receives signals HP-Home Position from Printer Mechanism, and informs MPU that Printer Head is at Home Position.
P3-3	INT 1-External Interrupt 1-This receives signals PF from Printer. PF-Paper Feed signals. This signals advances paper by one line by pressing PF switch each time or by PF signals from Printer mechanism each time.
P3-4	T 0-Timer 0 - External Input-This receives PWC-Pulse Width Control signals from Printer. This is used to control the Intensity of the Printing of the Printer. This is a software controllable signal to vary Intensity of Printing.
P3-5	T 1-Timer 1- External Input -This receives TP signal from Printer Mechanism. TP -Timing Pulse. This controls the Timing of Printing of Character.
P3-6	WR-External Data Memory Write Strobe. This signal is the Output signal from the MPU. This signal from MPU to write Data in to External Data memory U6-62C256.
P3-7	RD-External Data Memory Read Strobe. This signal is the Output signal from the MPU. This signal from MPU to Read Data from External Data Memory.

Timing Pulse :

Timing pulses are generated from Printer Mechanism by Motor. Sine wave pulses generated are converted into Square wave pulses by Transistor T2 and IC U2-pins 5 & 6 as MPU accepts and recognises only logic ??and logic ?? signals. 8 bit signals in the form of Dots of character goes to Printer Head to fire to print character. On the receipt of each Timing pulse, MPU sends one dot corresponding to character to Printer unit to print. Timing between printing of dots is controlled by Timing pulses.

Home Position:

There is a Microswitch on the left hand side of Mechanism. This is actuated when Printer Head touches to the Microswitch. This position is the Home Position of the Printer Head. Signal is sent to the MPU whenever microswitch is actuated. This signal is conditioned by RC network R4 and C18 and IC U2 pins-9 & 8. This informs MPU that Printer Head has moved to Home Position.

Pulse Width Control :

PWC is a self generating signal. It has no relation with either Printer or MPU. Printer Head is kept fired to print each DOT of character for 15 pulses. This is set by Trimpot. This signal goes to MPU to keep the Head fired or active on that DOT for time equivalent to 15 pulse. Trimpot is required to set for changing the Intensity of Printing means adjusting darkness of character.

PF-Paper Feed :

This signal goes to MPU to advance Paper by one line. This signal is also generated by software for advancing paper by one line.

5.0 REPLACEMENT SPARES :

Following Spares are required for repair of Thermal Printer Unit.

	SPARES	PART NO.
1.	Thermal Printer PC Board Assembly	BDIL 5300 A
2.	Thermal Printer Mechanism	BDIL 1111
3.	Paper Feed Switch	BDIL 1309
4.	Slide Switch	BDIL 1418
5.	9 Core Flat Cable with 9 Pin Female IDC both side	BDIL 1208

6.0 INDEX OF PICTORIALS :

SR NOS.	DESCRIPTION	DRAWING NOS.
1	Block Diagram	64050021
2	Thermal Printer PC Board Circuit Diagram	640300
3	Thermal Printer PC Board Assembly Diagram	64030301

7.0 TROUBLE SHOOTING :

This section contains the flow charts relevant to trouble shooting.

FLOW CHART	**DRAWING NOS**
Printer does not turn-慜N	64050022
Printer does not print	64050023